Cassini RADAR End of Mission Calibration and Preliminary Ring Results

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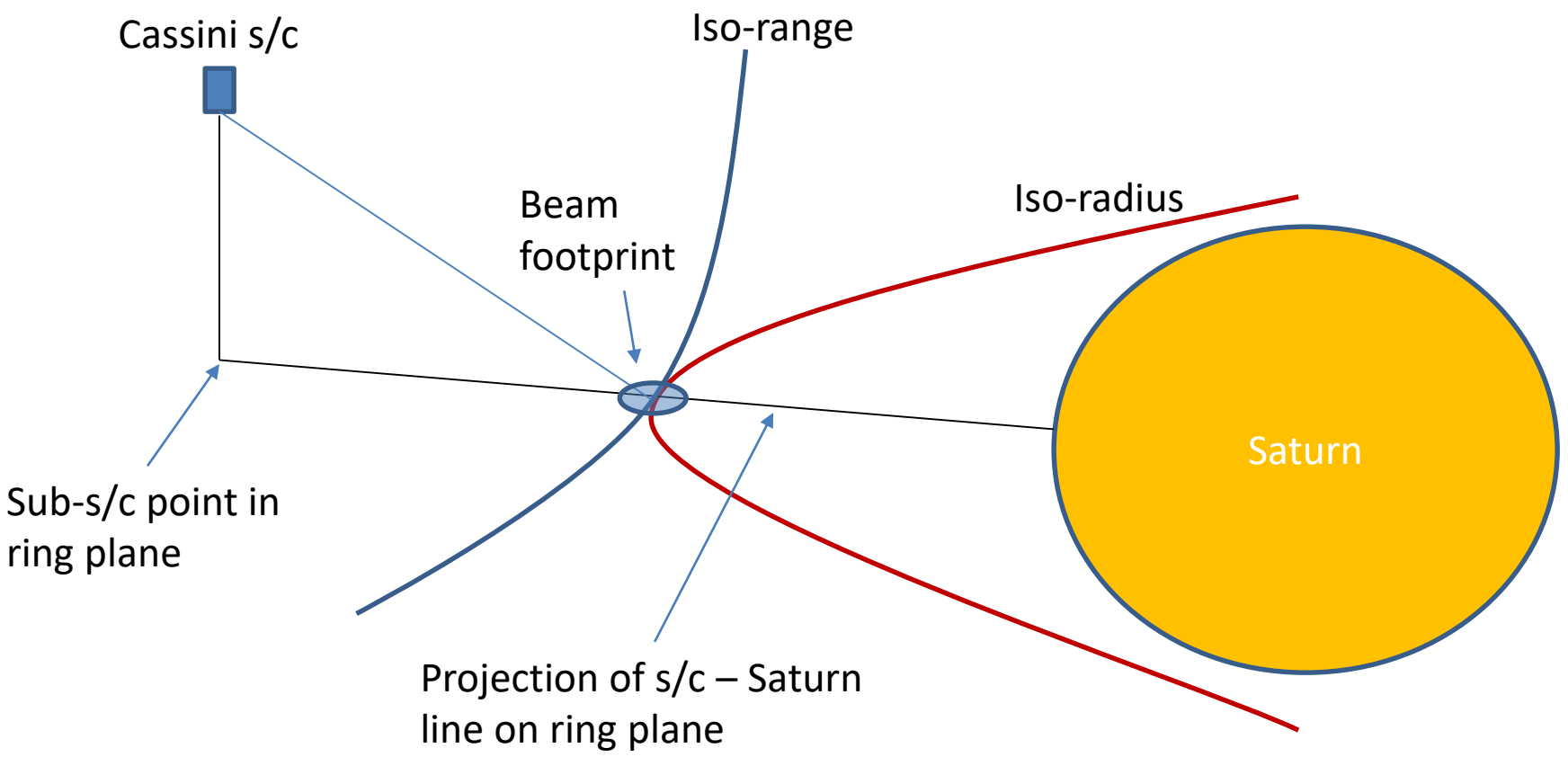
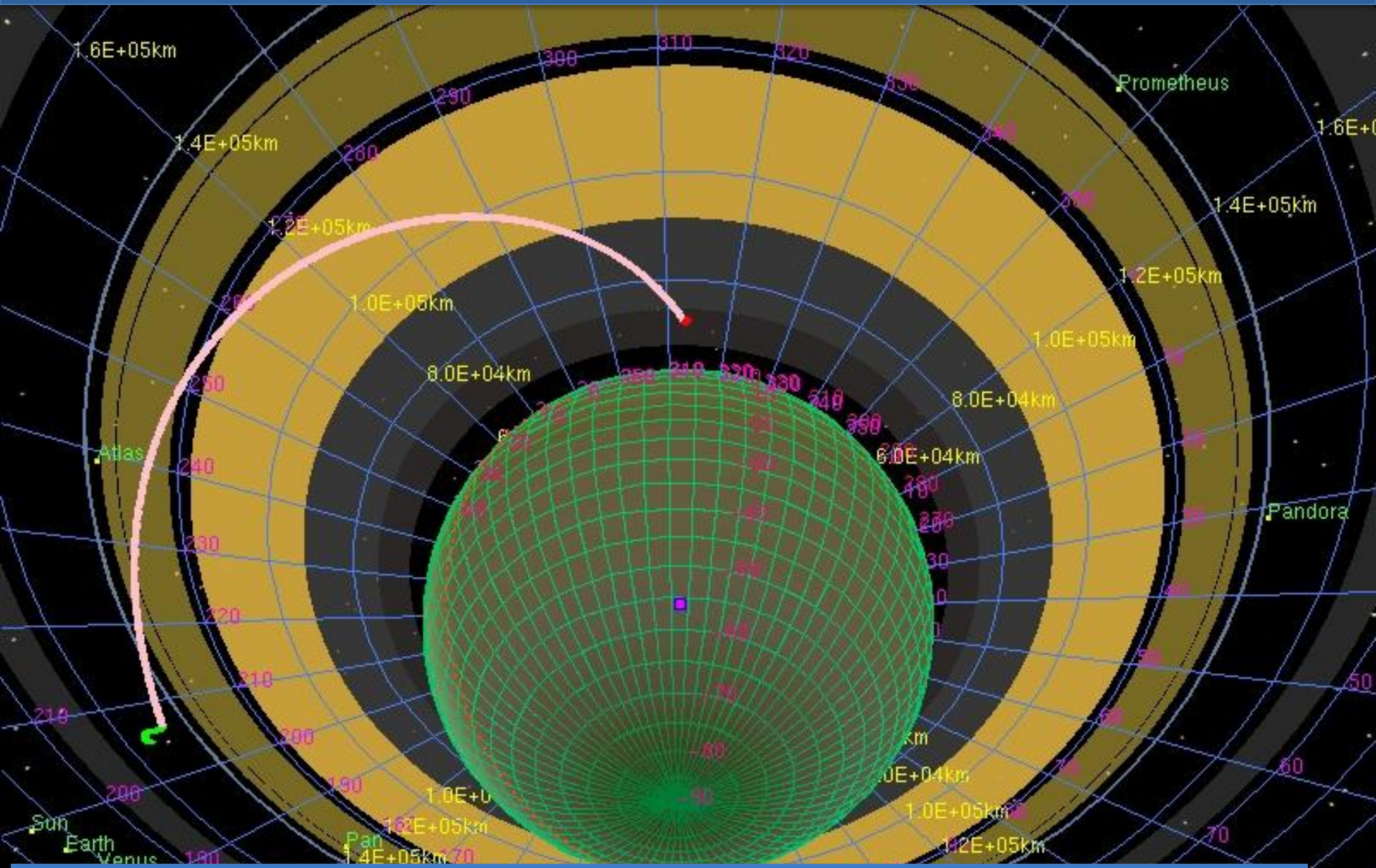
Outline

- Observing geometry during radar ring scans
- Raw power data
- Processing and Scaling
- Preliminary Calibrated backscatter
- Summary

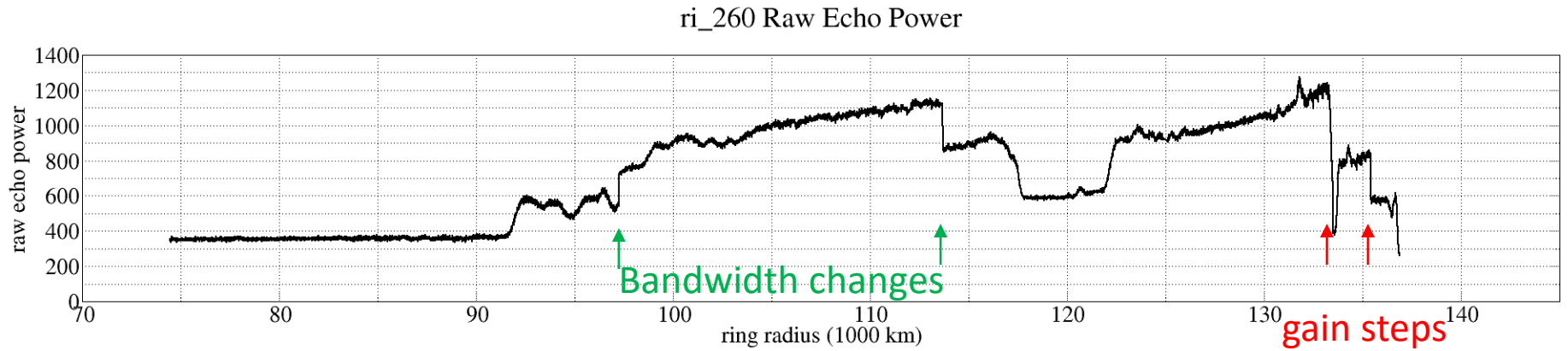
Observing Geometry

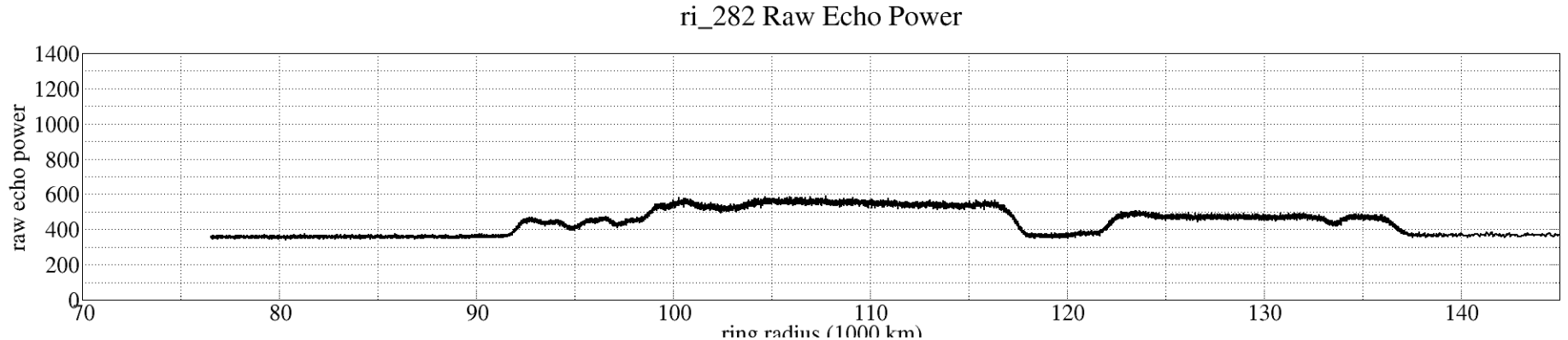


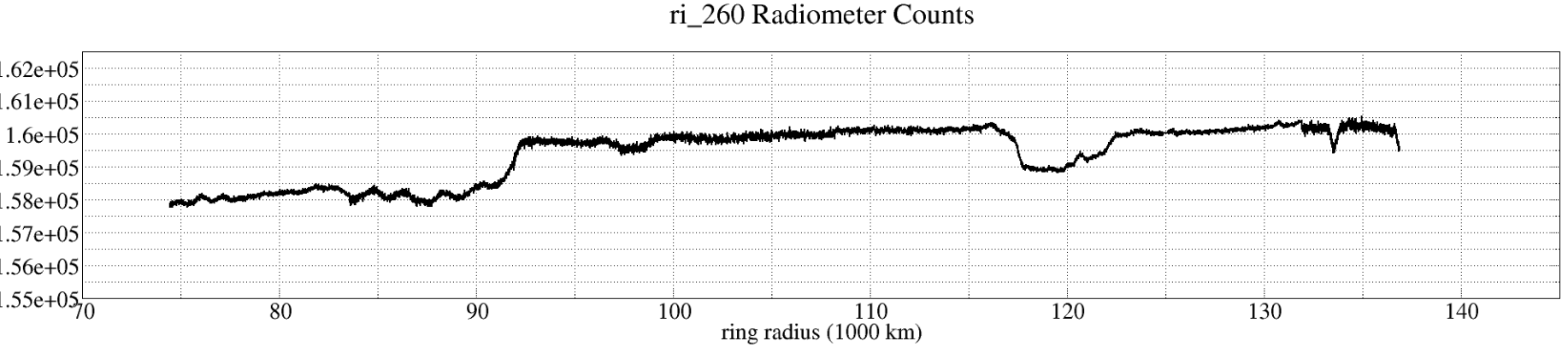

1.6E+05km
1.4E+05km
1.2E+05km
1.0E+05km
8.0E+04km
6.0E+04km
Prometheus
Pandora
Atlas
Sun
Earth
Venus
Pan

Ri_260

Uncalibrated Raw Powers From Rev 260 and Rev 282 Radar Ring Scans



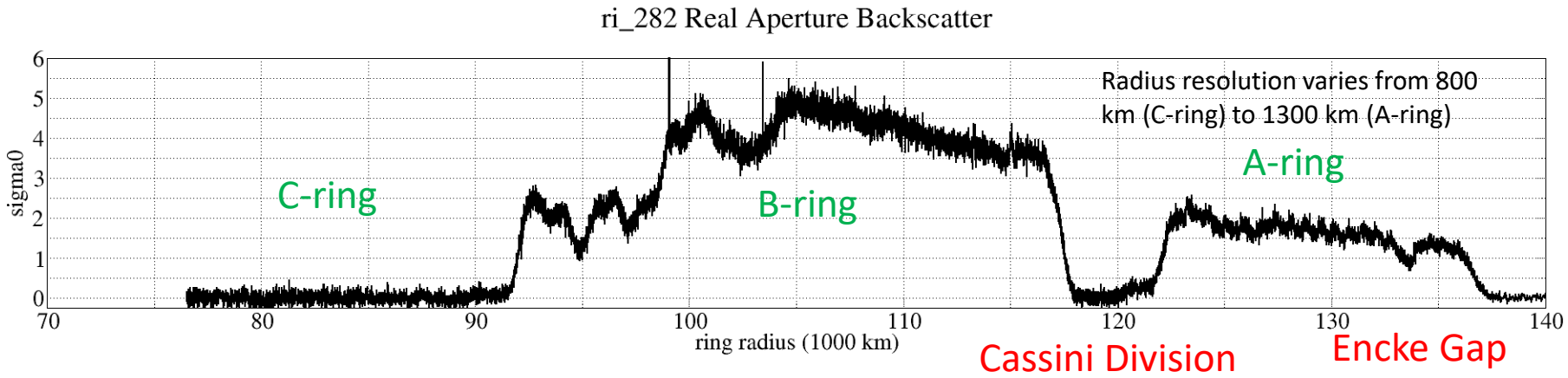


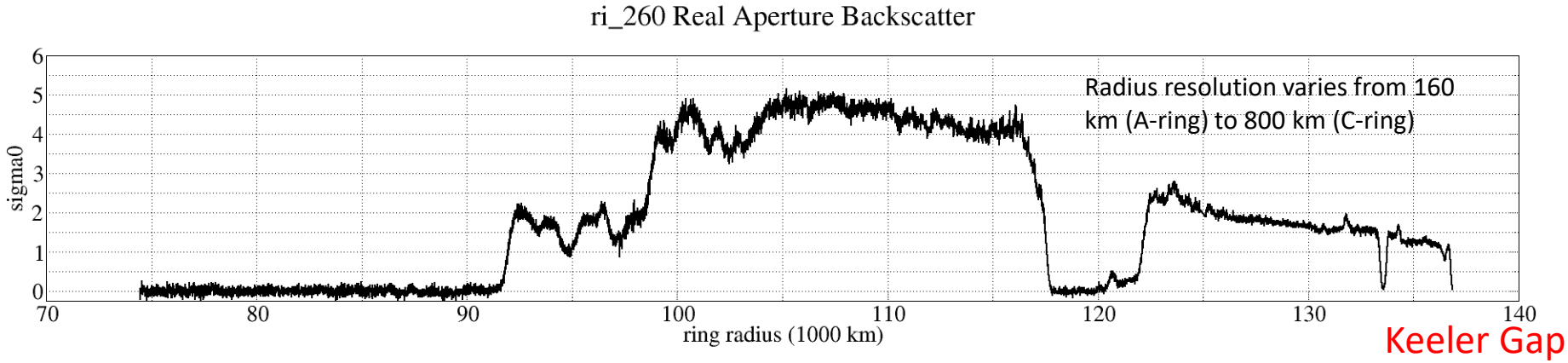


Scaling Raw Powers to Normalized Backscatter

- Raw echo power in data counts
  - $V_{sn} = 1/N_{rw} \Sigma |v(i)|^2$
- Noise Subtraction
  - $V_s = V_{sn} - V_n$
- Scaling from data counts to power in Watts
  - $P_s = C V_s \quad P_n = C V_n = kT_{sys}B_{rcv}$
  - C is a calibration conversion constant which depends on the attenuator setting and bandwidth mode.
- Radar Equation relates received power to normalized backscatter cross-section σ_0
  - $P_s = \lambda^2/(4\pi)^3 \int P_t u_{rw} G^2 \sigma_0 / R^4 \, dA$

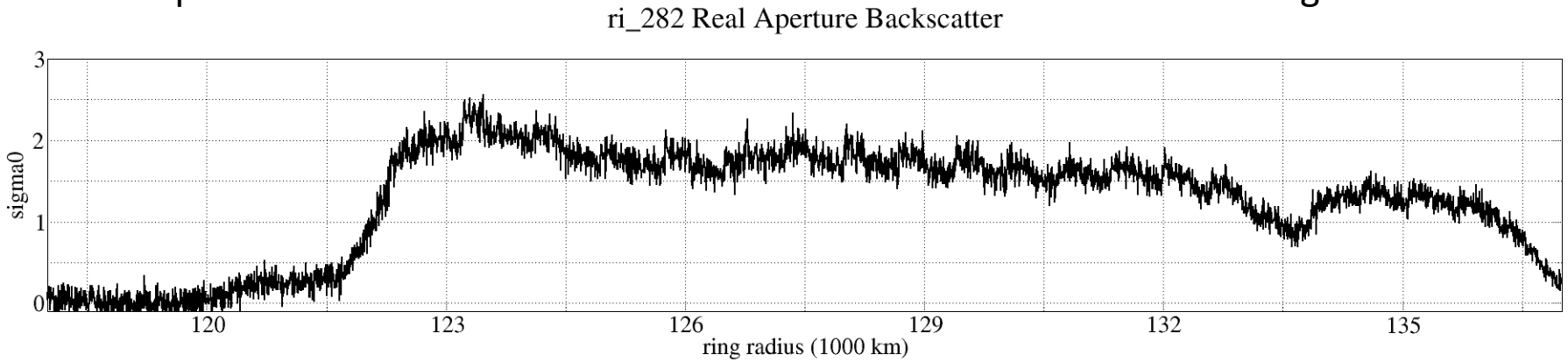
Calibrated Radar Backscatter From Rev 260 and Rev 282 Radar Ring Scans

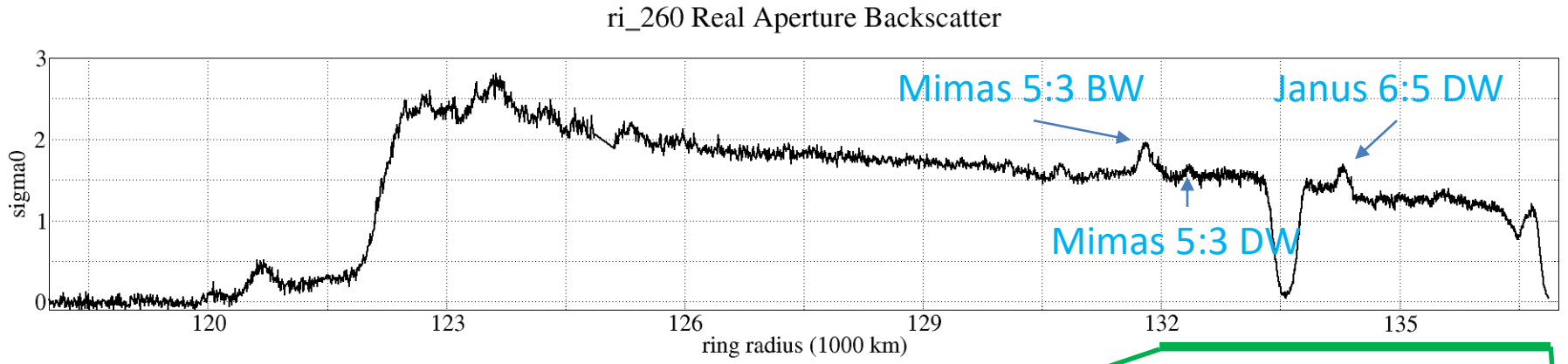


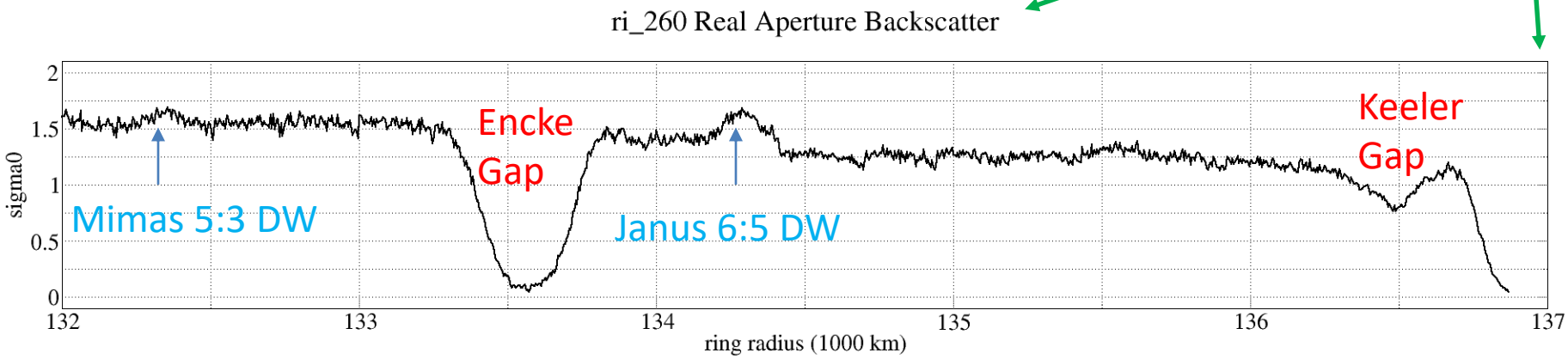


Note: sigma0 is normalized by projected area in the ring-plane and presented here in linear units. Unity sigma0 occurs when the received power equals what an isotropic scattering area would produce.

Expanded Views of Backscatter From Rev 260 and Rev 282 Radar Ring Scans







Summary

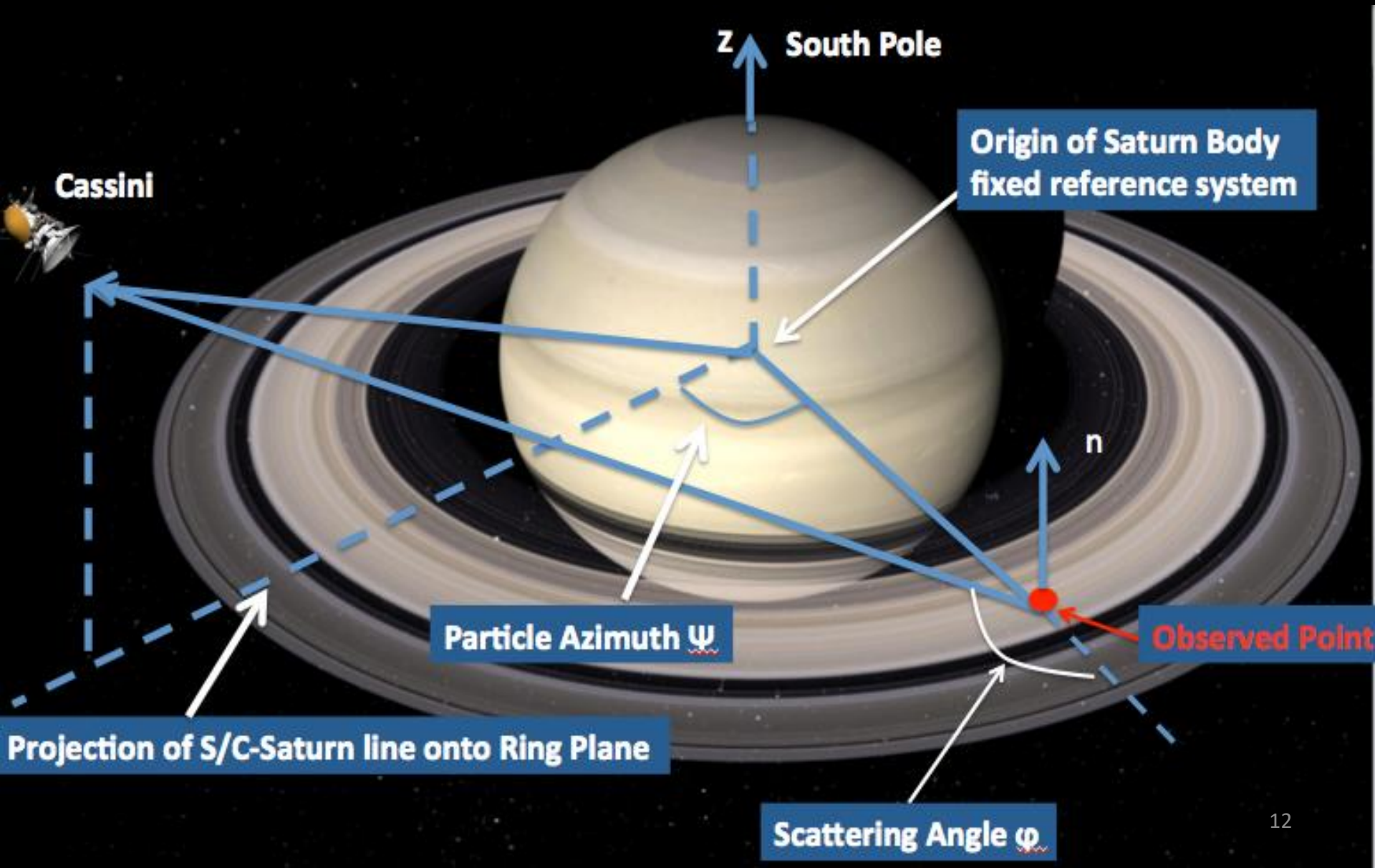
- Rapid variation of viewing geometry and radar parameters introduces some small-scale artifacts
- Consistent real aperture backscatter from ri_260 and ri_282
- Known ring features visible in radar data
- Ri_282 much lower resolution due to higher range
- Very high backscatter levels in A,B rings
  - Comparable to Xanadu on Titan and South polar region of Enceladus
  - Very low loss levels and complex dielectric structure at mm – cm scales.
- Range compression processing in progress
  - Resolutions down to a few km may be possible
  - Range ambiguities will pose a challenge for portions of the data

- Backup

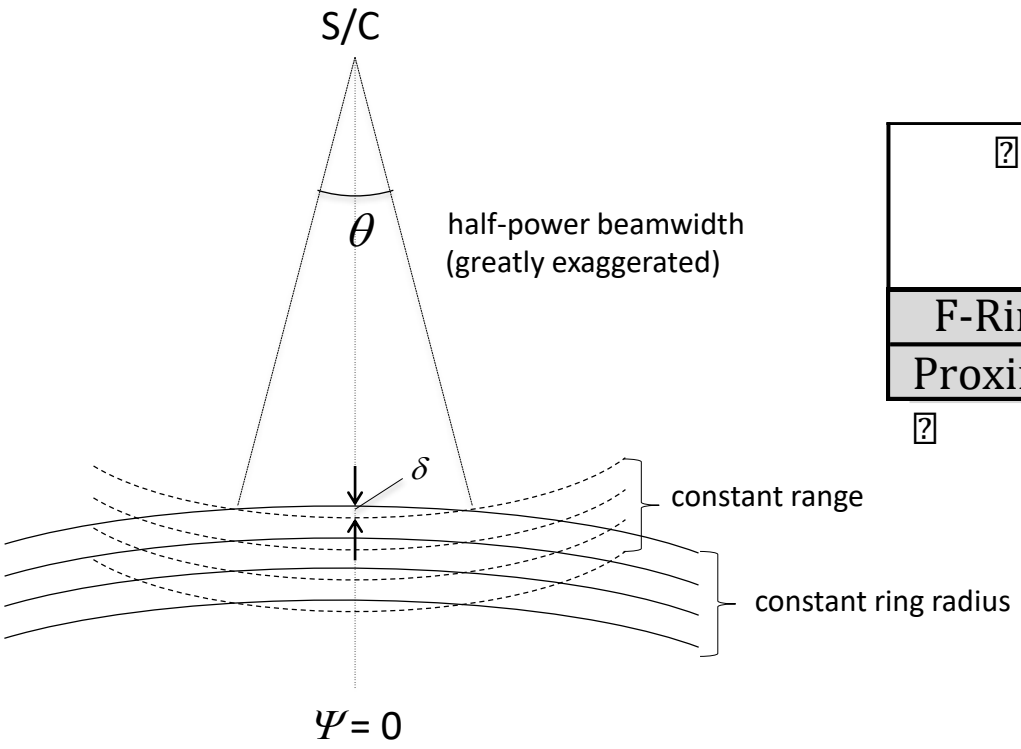
Radar Equation Details

- Rapid variation of viewing geometry and radar parameters requires detailed duty cycle correction to obtain accurate real aperture results.
- $P_s = \lambda^2/(4\pi)^3 \, P_{t0}\sigma_0/R^4 \int 1/N_{rw}\Sigma\Sigma p(t - i\tau_{pri}-2R/c) \, u_{rw}(t) \, G^2 \, dA$
- $p(t) = 1$ for $0 < \tau < \tau_p$, 0 otherwise
- $u_{rw}(t) = 1$ for $\tau_{rwd} < \tau < \tau_{rwd} + \tau_{rw}$, 0 otherwise

Observing Geometry



1-D Range Slicing



Geometric Smearing

δ	Inner C Ring [m]	Outer A Ring [m]
F-Ring Orbit	500	75
Proximal Orbit	80	450

Observing point centered at zero azimuth angle relative to spacecraft